Test and Training ENabling Architecture (TENA)

TENA BASELINE PROJECT REPORT

Volume V

Logical Range Business Process Model

Under Secretary of Defense (Acquisition & Technology)

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Abstract

The Logical Range Business Process Model (LRBPM) provides the reader with a definition of how to conduct a test or training exercise in the Logical Range environment. The Logical Range is a set of assets required to conduct a specific test or training event logically assembled into a system. The assets may come from one or more facilities. The ability to conduct a test or training exercise in a Logical Range environment means that test and training ranges, and facilities are no longer restricted to their local assets or resources. The Logical Range crosses physical and Service boundaries to achieve seamless interoperability, sharing and reuse of resources. To achieve the goal of enabling the multi-site, and multi-Service Logical Range environment, management and cultural changes will be needed. As a result, all phases of building and using the Logical Range call for common procedures and processes to enable a cost and time efficient capability to meet warfighter test and training needs.

The LRBPM defines a process that could be manual, semi-automated, or fully automated as it is transitioned into the test and training community. In conjunction with the Test and Training ENabling Architecture (TENA) Technical Reference Architecture (TRA), it supports the TENA Application Concepts. The LRBPM offers a broad view of the exercise development. It commences with the input of customer requirements and ends when all data and financial issues are closed. The LRBPM relies on the utilization of browser-based technology proposed in the Logical Range support tool for full implementation. Development of this tool will be done following the Product Line Approach as discussed in Volume II of the TENA Baseline Report.

In addition to the process definition, the LRBPM report presents implementation issues which facility users, e.g., acquisition managers, training coordinators, test directors, and program managers will need to address in the multi-site/multi-Service environment. Finally, it recommends subsequent actions for process validation, model refinement, and implementation.

The opinions, ideas and recommendations presented in the TENA Baseline Project Report are the views of the TENA Project Team and do not necessarily represent those of the Sponsor.

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Purpose

This definition of the Logical Range Business Process Model (LRBPM) describes the steps and activities to be followed when conducting a Logical Range test or training exercise. In conjunction with the Test and Training ENabling Architecture (TENA) Technical Reference Architecture, it supports the TENA Application Concept of the Logical Range.

Readership

This document is intended for use by test and training range and resource managers, operation directors, test planners, test conductors, as well as potential customers and Logical Range systems developers.

Volume Guidance

The Logical Range Business Process Model definition has been mapped into process diagrams utilizing IDEF0 (Integrated Computer Automated Manufacturing Definition) modeling techniques. IDEF0 modeling offers a convenient technique that enables people to understand complex systems. (For a tutorial on how to read IDEF0 diagrams, see Appendix F.) Summarized and detailed process definitions are offered in this volume. For the purpose of identifying LRBPM terminology, terms are italicized in the Introduction and in the Hi-level Process Definition. These terms are defined in Appendix C, LRBPM Dictionary. Implementation issues are identified and recommendations for subsequent actions, process validation, model refinement and implementation are also offered. Appendix D presents business processes from ranges visited. These were used to develop the "as-is" Business Process Model for a Test/Training Exercise found in Appendix E. This version of the LRBPM is a baseline for review. Readers are encouraged to participate in refining the model and other sections of this volume by contacting the TENA Project Office.

Relationship to other Volumes

This volume provides a detailed explanation and process definition of the steps and activities to be followed by the Logical Range Business Process Model. Additional information regarding the execution of a test or training exercise, how the LRBPM relates to the TENA Object Model can be found in Volume VI TENA Application Concepts. Information regarding the Product Line Approach can be found in Volume III.

Readers are encouraged to review Volume I, Management Overview which contains an introduction to the TENA project, and to seek additional detailed information by consulting the appropriate volume.

PROJECT NEED

TENA is part of a coordinated response by the Central Test and Evaluation Investment Program (CTEIP) office to several current and emerging challenges in the test and training range and resource community. These challenges include:

- Reducing software development and maintenance cost,
- Utilizing common instrumentation at multiple facilities,
- Responding to the increased demand for multiple-site exercises and/or exercises which cross T&E/training or live/virtual/constructive boundaries,
- Responding to the increased demand for consistency of information between facilities and across phases of the acquisition process, and
- Capturing critical data to support informed customer and management decisions about resource needs, capabilities, and investments.

PROJECT PURPOSE

The purpose of the TENA project is to respond to these challenges through the establishment of an architecture that efficiently and effectively fosters the sharing, reuse, and interoperability between cooperating Department of Defense (DoD) test ranges and facilities, training ranges, laboratories, and other modeling and simulation activities. The expected synergism will permit efficient and effective testing of new and enhanced weapons systems and will vastly improve the scope and fidelity of worldwide joint/combined training.

PROJECT HISTORY

The Test and Training ENabling Architecture (TENA) project concept was formulated in FY95 by a multi-Service working group. This concept was endorsed by the Test and Evaluation Reliance Investment Board (TERIB), the Board of Operating Directors (BoOD), and the Test and Evaluation Resource Council (TERC).

The Navy is the CTEIP Resource Manager for this project, and has established a Joint Project Office (JPO) for the management of project activities at the Naval Undersea Warfare Center (NUWC) Division, Newport, RI.

Shortly after assembly of the Joint Service Team, several critical observations were made:

- The key to interoperability is not connectivity alone, but rather understanding

communications content. This is best promoted by defining an open, object-oriented software architecture that could be used by both legacy and newly built systems.

- The process used to plan, schedule, and otherwise coordinate a multiple-facility, multiple-service exercise must be integral to the development of the architecture, or the capabilities it offers might never be fully utilized.

- The architecture must be conducive to refinement over time and coexists with facility-unique applications. This requires a disciplined architecture development/refinement process. The team adapted the Defense Information Systems Agency (DISA) domain-engineering approach to help develop the architecture and recommends the Product-Line Approach for implementation and life-cycle maintenance.

- Significant investments are being made in other closely related areas such as, Defense Modeling and Simulation Office (DMSO), High Level Architecture (HLA) and the Joint Simulation System (JSIMS) program. TENA must leverage as many of these efforts as practical.

- The TENA concept is radically new to our community. Planning for transition is key to its ultimate acceptance.

STATUS

The project team tested its architecture development process in FY96 producing a "Pilot Architecture." This work was reviewed in several public forums. These reviews were highly supportive of TENA's effort. Two consistent suggestions were that TENA should focus first "on breadth, not depth", and that there should be more emphasis on "problem-space vs. solution-space". These considerations and additional engineering effort has resulted in this refined "Baseline Architecture."

The TENA Baseline contains sufficient detail to continue further analysis and risk reduction efforts and is a good vehicle for discussion, experimentation, and refinement. It is not yet appropriate to use these documents as the blueprint for a major system development. After community feedback, results from risk-reduction prototypes, experiments, and other ongoing efforts are synthesized, the cognizant TENA Baseline documents will be updated as "TENA Rev 0." TENA Rev. 0 will be the appropriate source of design information for a TENA-compliant system implementation.

The Logical Range Business Process Model (LRBPM), outlines and defines the steps and activities to be followed when conducting a Logical Range test or training exercise. In conjunction with the TRA it supports the TENA Application Concepts for the execution of a test or training exercise. The LRBPM relies on the utilization of browser-based technology proposed in the Logical Range Support Tool for full implementation.

Development of this tool will be done following the Product Line Approach as discussed in Volume II of the TENA Baseline Report.

The Logical Range is a range without geographic boundaries. An instance of the Logical Range is created at a point in time when specific customer requirements dictate a need for interoperability, sharing or reuse of resources. Resources or assets may include platforms, instrumentation, software modules, test or training exercise plans or data products, models, simulators, air or water space, computers and stimulators. The Logical Range meets *customer requirements* when it creates a dynamic entity which schedules and integrates resources, plans, executes and delivers a *customer data package*. It allows facilities and test or training ranges to expand their capabilities and provide more comprehensive resources and services assembled to meet *customer requirements*.

The LRBPM was developed to enable the business processes that pertain to building and using a Logical Range. It supports all phases of test and training conduct. The LRBPM provides a standard process that maintains current test and training business processes integrity and functionality but allows for distributed, multi-site, and multi-Service exercise development. TENA Project staff followed a three-step process to develop the LRBPM. First, business process information was collected from interviews with test and training subject matter experts from all Services, and range business process documentation (See Appendix D). Second, the staff created a generic business process model that mapped current test and training ranges business process (See Appendix E). This generic process was reviewed and validated by test and training subject matter experts. Third, the staff developed the LRBPM to support test and training in the Logical Range environment.

The LRBPM is a *customer* and *scenario* based process. A *customer* is defined as a person, command, or organization that has a need to sponsor a test or training exercise. A *scenario* is the combination of environment, participants, events and resources which can be used to meet the test or training customer requirements. In the LRBPM the *customer* has control of all the activities and collaborates in the scenario definition, planning, scheduling, executing and reviewing phases of the Logical Range test or training exercise. A *scenario* is one viable way of meeting *customer requirements.* There could be one or more viable scenarios. The *Logical Range scenario* is the particular *scenario* selected to be utilized for planning of a specific instance of a Logical Range. The *Logical Range scenario* is composed of a mission space definition and Logical Range Resources. Mission space corresponds to the combination of environment, participant and events parameters which will provide information for *primary resources assignment*. Logical Range primary resources correspond to essential or high-level resources that are paramount for the Logical Range. The Logical Range resources include facility or range specific assets that are required to support primary resources in the execution phase. These include both secondary and logistics resources.

The LRBPM commences with inputs of *customer requirements* and concludes when a *customer data package* is delivered. The LRBPM imposes no time constraints on the instantiation of a Logical Range. It allows for iterative activities to revisit earlier steps in

order to change parameters or adjust specifications. The *Logical Range manager* and the *customer* are two of the principal roles defined by the Logical Range. The *Logical Range manager* is one of the mechanisms that enables the process and is considered a s*ubject matter expert*. The *Logical Range manager's* role is to aide the *customer* with every step of using the Logical Range capability. The *Logical Range manager* could be facility or range program managers, customer representatives, single face points of contact or other facility or range specific customer liaison.

The LRBPM provides for process improvement of each phase by compiling managerial and operational understanding from *lessons learned*. *Lessons learned* apply to all phases and should be reviewed by the *Logical Range manager, customer* and facility or other range personnel involved in the Logical Range instantiation.

The LRBPM is composed of five major activities: Define a Logical Range Scenario, Schedule Logical Range, Plan, Execute Plan, and Closeout, as shown in Figure 1.

Figure 1. Conduct a Logical Range Test or Training Exercise Process

Define a Logical Range Scenario

Define a Logical Range *scenario* initiates the process by establishing the boundaries to be utilized to define *scenarios*. In this first activity the Logical Range *scenario characteristics* are defined by the Logical Range *manager* and the *customer.* These characteristics include the type of test or training exercise, environment attributes, event definitions, participants or particular resources. These are identified as parameters for scenario definition to the Logical Range *support tool.* There may be several viable *scenarios* that will satisfy *customer requirements.*

These *scenarios* are then matched to current facility or range capabilities to determine if required capabilities do exist to support the desired scenarios. In the event that *scenario requirements* cannot be matched to an existing facility or range capability, the *customer* and the Logical Range *manager* can redefine the *scenario characteristics* or conclude that new capabilities are required for successful *customer requirements* matching. If new capabilities are required, then facility or range management will evaluate the Unmatched *requirements* to determine if the time and/or cost of developing those new capabilities could still allow for *customer requirements* satisfaction. The ability to

consistently and reliably provide this information to facility and range managers is a tremendous value added to the acquisition management process. Once the *scenario requirements* have been matched, a *cost estimate* is developed for each Scenario. With a *cost estimate*, *scenarios* and *customer requirements* as inputs the Logical Range *manager* and the *customer* select the Logical Range *scenario.* The Logical Range *primary resources schedule requirements* are also defined at this time.

Schedule Logical Range

The second phase of the LRBPM is *schedule* Logical Range. During this activity the Logical Range *primary resources assignment* and the Logical Range *working schedule* are developed. First, the *primary resources availability report* is developed by browsing the Joint, Service Ranges/Facilities schedules. TENA-compliant facilities and ranges will post their Logical Range *resources* scheduling information so that it is available to the browser-based tool. The Logical Range *support tool* will search for the availability of the *primary schedule requirements* and will develop the *primary resources availability report* containing among other data, the availability dates and the corresponding facility or range.

The second phase of the scheduling activity is to *optimize the schedule* using an optimization tool to develop the most viable Logical Range *working schedule* and Logical Range *primary resources assignment*. The working schedule will be used for planning and executing purposes. It is labeled "working" to imply the volatility of the information contained within. The Logical Range *manager* and the *customer* make changes or time adjustments until the execution phase begins.

Plan

The third phase of the LRBPM is to *plan* the Logical Range test or training exercise. During this phase a detailed Logical Range *plan* and a *refined cost estimate* are developed. This activity establishes the Logical Range *operating financial environment* by creating the *financial documentation*, defines and coordinates *secondary* and *support requirements* which are contained in the *logistics annex*, refines the *cost estimate*, and compiles the Logical Range *plan*. Support *requirements* include among other communications channels, computation requirements, financial, display and data reduction or transfer. The *logistics annex* outlines the safety, environmental, air/water space and other plans. It includes particular chapters dedicated to facility or range specific documentation. The Logical Range *plan* is the single document that contains all Logical Range information. The level of detail required on each plan is determined by *customer requirements* as well as by the Logical Range *procedures* and the *facility/range procedures* which control each Logical Range *primary resource.*

Execute Plan

The fourth phase of the LRBPM is *execute pan*. This activity provides the Logical Range *manager* with the steps to follow during the execution phase which commences with *setup* and concludes with a *debrief.* During this phase of the Logical Range

instantiation, the Logical Range *manager* will utilize as guidance the Logical Range *plan. Financial data* as well as event Logs are collected during execution to be used during the Closeout phase. Once the execution has been completed a Preliminary Data Package is prepared. The last step of the execution process is to Debrief the execution of the test or training exercise. The Logical Range *manager, customer, and supporting staff* will be involved during the debrief.

Closeout

The final phase of the LRBPM is the *closeout* phase. At this time four activities are performed which commence with *collect customer feedback* and end with *resolve/close payment/data issues*. The final outputs of the *closeout* phase are the *customer data package* (which is delivered once any data or financial issues have been resolved) and the Logical Range *lessons learned*. *collecting customer feedback* allows the Logical Range *manager* as well as facility/range Logical Range *resource* provider with valuable information regarding managerial, operational and performance feedback regarding the Logical Range instance. The *customer data package* is verified with the purpose of allowing the Logical Range *manager* and the *customer* to review the results and determine whether provided data products comply with the plan specifications and *customer requirements.*

Payment issues are identified by comparing the *financial data* collected during the execution phase to the *financial documentation* and *refined cost estimate*. Some *payment issues* that could arise include deviations from the *refined cost estimate* or funding not received by any Logical Range *resource* provider. In order to properly close a Logical Range instance two things are normally required, all financial and data issues must be resolved and a *customer data package* must be delivered to the *customer*. A compilation of specific managerial, operational, performance, and financial *lessons learned* is the final product of the process. The Logical Range (LR) *lessons learned* will be kept on a Logical Range repository for future review of Logical Range users.

The following is a detailed process definition utilizing IDEF0 process modeling mapping techniques. IDEF0 modeling defines a process as the interaction of activities which are influenced by inputs, controls and mechanisms that yield desired outputs. It depicts the process utilizing boxes for activities and arrows to represent the inputs, outputs, controls and mechanisms. Inputs (on the left) are transformed into outputs (on the right). Controls (on the top) govern the way the transformation or process is done. Mechanisms (on the bottom) indicate the means by which the function is performed. A "mechanism" (or support) might be a person, a committee, a machine, a tool, or a process. Figure 2 presents an example of an IDEF0 process.

Figure 2. Representation of a IDEF0 Diagram Process Mapping

These models permit iterative processes which allow for re-visiting an activity in order to modify parameters. For a detailed description on how to read IDEF0 diagrams see Appendix E.

To facilitate the understanding of the LRBPM, the following detailed definition is organized in a hierarchical fashion. There are inputs, outputs, controls and mechanisms that influence the whole process. These are introduced to the reader in the context diagram which is the highest level of abstraction of the process. A definition for each activity will be offered and each activity's inputs, outputs, controls and mechanisms will be presented. Arrow and activity definitions are contained in Appendix C, LRBPM Dictionary.

NOTE*: The detailed explanation of the process will use as illustration for each activity an expansion of the node diagram presented in figure 4. IDEF0 diagrams are contained in a pull-out sheet following the A-0 diagram explanation. For readers who have acquired this report electronically, the IDEF0 diagrams are contained in Appendix F. The pull-out sheet is a convenient way to view activities in one page. Readers are encouraged to review the diagrams as they read the process explanation.*

A-0 Conduct a Logical Range Test/Training Exercise

Figure 3, illustrates the context diagram or A-0 diagram of the LRBPM. It shows the arrows that play a major role in the "Conduct a Logical Range Test/Training Exercise" process.

Figure 3. Context Diagram for Conduct a Logical Range Test/Training Exercise

This activity illustrates the highest level of abstraction of the process to conduct a test/training exercise in the Logical Range environment. It illustrates the major inputs, outputs, controls, tools and mechanisms required for the process. At this level we can show that Customer Requirements enter as input to the Conduct a Logical Range Test/Training Exercise process, while the process utilizes a Customer, Joint, Service, Facilities/Ranges Schedules and LR Procedures as controls, and Subject Matter Experts, Tools and Support Staff as mechanisms. As outputs the process shows a Customer Data Package, Lessons Learned or Unmatched Requirements.

Inputs: Customer Requirements

Outputs: Customer Data Package, Unmatched Requirements, Lessons Learned

Controls: Customer, Joint, Service, Facilities/Ranges Schedules, LR Procedures

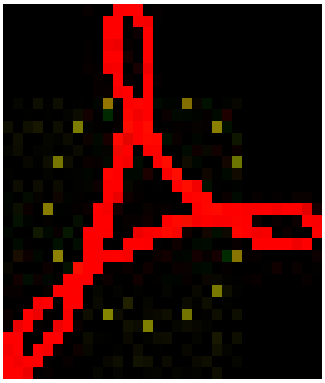
Mechanisms: Subject Matter Experts, Tools, Support Staff

A0 Conduct a Logical Range Test/Training Exercise

The A0 diagram offers the next level of abstraction of the model. It shows the major activities or steps that the process will follow. Figure 4 shows a node diagram for the process while Figure 5 presents the IDEF0 A0 diagram which maps all the 5 major activities and their inputs, outputs, controls, and mechanisms. Arrows that are not connected to any box influence or are outputs of **all** boxes in the process. For example, the Customer and LR Procedures control all activities, Tools are used as mechanisms, and Lessons Learned is an output to all the activities. The A0 diagram shows how major activities relate to another and

what are the input-output arrows that flow through the process. For example, the LR Scenario output from the Define a Logical Range Scenario activity is required as input for the Plan activity. It is important to note that not all arrows are represented in the A0 diagram. There are other arrows that will appear in each of the individual activity levels. These are not shown in A0 in order to maintain clarity.

Figure 4. Node Diagram Representation of the LRBPM



Acrobat Document

A1.0 Define Logical Range Scenario

During this activity the LR Scenario that best meets customer requirements is determined. There may be several valid scenarios which can be used to achieve the same test/exercise objectives. The customer and the LR Manager determine the best candidate to achieve Customer Requirements satisfaction based on resource, technology, or capability availability, time or budget constraints and other factors.

Inputs: Customer Requirements

Outputs: Lessons Learned, Unmatched Requirements, Cost Estimate, LR Scenario, Primary Schedule Requirements

Controls: LR Procedures, Facility/Range Capability Description, Customer, Ranges/Facilities Procedures

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A1.1 Define Scenario Characteristics

During this activity the acceptable boundaries or specifics that the LR Scenario will use to meet customer requirements are determined. These boundaries are selected as inputs, ranges or limits for the construction of the scenarios. Scenario characteristics include: type of test/training exercise, environment, events, participants, or particular LR Resources.

***Inputs*:** Customer Requirements

Outputs: Scenario Characteristics and Lessons Learned

Controls: LR Procedures, Customer, and Ranges/Facilities Procedures
Mechanisms: Subject Matter Experts, Support Staff, and Tools

A1.2 Define Scenarios

During this activity the customer, and the LR Manager will define the scenario to be ultimately used as an input to the planning phase. Criteria utilized to achieve LR Scenario definition could be but will not be limited to: resource/technology availability, and time or budget constraints.

Inputs: Customer Requirements, Scenario Characteristics

Outputs: Scenarios Requirements, Scenarios, and Lessons Learned

Controls: LR Procedures, Customer, and Ranges/Facilities Procedures

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A1.3 Match Capabilities to Scenario Requirements

This activity will utilize existing facilities/ranges capabilities, and defined scenarios to determine if customer requirements could be met.

Inputs: Customer Requirements, Scenarios Requirements, and Scenarios

Outputs: Unmatched Requirements, Matched Requirements, and Lessons Learned

Controls: LR Procedures, Facilities/Range Capability Description, Customer, and Ranges/Facilities Procedures

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A1.4 Develop Cost Estimate

This activity develops the test/training exercise estimated costs based on the Scenario Requirements, and cost information provided by the supporting facilities/ranges.

Inputs: Customer Requirements, Scenarios, and Matched Requirements

Outputs: Cost Estimate, and Lessons Learned

Controls: LR Procedures, Facilities/Range Capability Description, Customer, and Ranges/Facilities Procedures

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A1.5 Select LR Scenario

During this activity the LR Manager in conjunction with the Customer decide the LR Scenario to be used to conduct the test/training exercise.

Inputs: Customer Requirements, Cost Estimate, Matched Requirements, and Scenarios

Outputs: Lessons Learned, LR Scenario, and Primary Resources Assignment

Controls: LR Procedures, Customer, and Ranges/Facilities Procedures

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A2.0 Schedule Logical Range

During this activity the LR primary resources will be scheduled following established LR scheduling procedures, and utilizing the LR scheduling tools.

Figure 7. A2.0 Node Diagram Highlighting "Schedule Logical Range"

Inputs: Primary Schedule Requirements, LR Scenario, Customer Requirements

Outputs: LR Working Schedule, Lessons Learned, and LR Resources Assignment

Controls: Joint, Service, Facilities/Ranges Schedules, LR Procedures, and Customer

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A2.1 Determine Logical Range Resources Availability

During this activity the accessibility of high-level or essential resources is determined utilizing the Primary Schedule Requirements, the Joint, Facilities/Ranges Schedules, and the LR scheduling tools, and procedures.

Inputs: Primary Schedule Requirements, LR Scenario, and Customer Requirements

Outputs: Primary Resources Availability Report, Lessons Learned

Controls: Joint, Service, Facilities/Ranges Schedules, LR Procedures, and Customer

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A2.2 Optimize Logical Range Schedule

During this activity the facilities/ranges schedules, and the LR Primary Resources Availability Report are utilized in conjunction with the schedule optimization tool to generate Optimized LR Resources.

Inputs: Primary Resources Availability Report, and Customer Requirements

Outputs: LR Working Schedule, LR Primary Resources Assignment, and Lessons Learned

Controls: Joint, Service, Facilities/Ranges Schedules, LR Procedures, and Customer

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A3.0 Plan

Preparation, coordination, and production of the detailed LR Plan. During this activity there are four efforts - establishing LR operating financial environment, define, and coordinate secondary, and support requirements (included in the Logistics Annex), and compilation of the LR Plan.

Figure 8. Node Diagram Highlighting "Plan"

Inputs: Cost Estimate, LR Working Schedule, LR Scenario, Customer Requirements, and LR Primary Resources Assignment

Outputs: Lessons Learned, Financial Documentation, Refined Cost Estimate, LR Plan

Controls: Ranges/Facilities Procedures, Facility/Range Capability Description, Customer, and LR Procedures

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A3.1 Establish LR Operating Financial Environment

During this activity the LR Manager generates the required financial documentation for each organization involved in the Logical Range.

Inputs: Cost Estimate, LR Scenario, and Customer Requirements

Outputs: Financial Documentation, and Lessons Learned

Controls: Ranges/Facilities Procedures, Customer, and LR Procedures

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A3.2 Define Secondary & Support Requirements

Identification of test/training exercise facility/range specific requirements as well as logistics support requirements. Logistics support could include financial, communications, computation, personnel, security, safety, and environmental.

Inputs: Financial Documentation, LR Working Schedule, LR Scenario, Customer Requirements, and LR Primary Resources Assignment

Outputs: Secondary & Support Requirements Definition, and Lessons Learned

Controls: Ranges/Facilities Procedures, Financial Documentation, Facilities/Ranges Capability Description, Customer, and LR Procedures

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A3.3 Coordinate Secondary & Support Requirements

The organization of facility or range specific support resources, and services required by the LR test/training exercise for execution.

Inputs: Secondary & Support Requirements Definition, LR Scenario, Customer Requirements, LR Primary Resources Assignment, and Financial Documentation

Outputs: Logistics Annex, and Lessons Learned

Controls: Ranges/Facilities Procedures, Customer, LR Procedures, and Financial Documentation

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A3.4 Compile LR Plan

Organization, and assembly of all required information for the test/training exercise execution plan.

Inputs: Cost Estimate, LR Working Schedule, LR Scenario, Customer Requirements, LR Primary Resources Assignment, Logistics Annex, and Financial Documentation

Outputs: Refined Cost Estimate, LR Plan, and Lessons Learned

Controls: Ranges/Facilities Procedures, Customer, and LR Procedures

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A4.0 Execute Plan

During this activity the execution of the LR Plan is followed beginning with the setup for the exercise, execution, preparation of the Preliminary Data Package, and final debrief of the exercise.

Figure 9. Node Diagram Highlighting "Execute Plan"

Inputs: LR Plan

Outputs: Lessons Learned, Logs, Financial Data, Data Products, Preliminary Data Package, and Debrief Report

Controls: Ranges/Facilities Procedures, LR Procedures, Financial Documentation, and Customer

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A4.1 Setup

The steps followed to prepare for plan execution. These are LR specific, and will follow LR Procedures as well as Ranges/Facilities Procedures.

Inputs: LR Plan

Outputs: Pre-Test Brief, and Lessons Learned

Controls: Ranges/Facilities Procedures, LR Procedures, Financial Documentation, and Customer

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A4.2 Execute

During this activity the LR Plan will be followed to carry out the operational aspects of performing the test/training exercise.

Inputs: LR Plan, Pre-Test Brief, and Ranges/Facilities Procedures

Outputs: Logs, Financial Data, Data Products, and Lessons Learned

Controls: Ranges/Facilities Procedures, LR Procedures, Financial Documentation, and Customer

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A4.3 Prepare Preliminary Data Package

Compiling the test/training exercise data before it has been reviewed by the Customer to determine accuracy, and completeness. The format, presentation, and delivery of the Customer Data Package will be specified in the LR Plan.

Inputs: Data Products, and LR Plan

Outputs: Preliminary Data Package, and Lessons Learned

Controls: Ranges/Facilities Procedures, LR Procedures, Financial Documentation, and Customer

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A4.4 Debrief

Post execution assessment of the LR test/training exercise.

Inputs: Preliminary Data Package, and LR Plan

Outputs: Lessons Learned, and Debrief Report

Controls: Ranges/Facilities Procedures, LR Procedures, Financial Documentation, and Customer

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A5.0 Closeout Test

During this activity all performance, and data/cost issues are resolved, the customer data package is delivered, and financial matters are closed.

Figure10. Node Diagram Highlighting "Closeout"

Inputs: Debrief Report, Preliminary Data Package, and Financial Documentation

Outputs: Lessons Learned, Customer Data Package, and LR Lessons Learned

Controls: Customer, LR Plan, LR Procedures, Refined Cost Estimate, Ranges/Facilities Procedures, and Financial Documentation

Mechanisms: Subject Matter Experts, Support Staff, Tools, and Questionnaires

A5.1 Collect Customer Feedback

During this activity the LR manager in conjunction with the facilities involved in the execution of the plan will query the customer for comments regarding the quality, accuracy, and overall management of the test/training exercise.

Inputs: Debrief Report

Outputs: Customer Feedback, and Lessons Learned

Controls: Customer, LR Plan, and LR Procedures

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A5.2 Verify Preliminary Data Package

During this activity the preliminary data package is validated against the specifications outlined in the plan. The customer may be part of this activity, and may accept or reject the data package.

Inputs: Customer Feedback, and Preliminary Data Package

Outputs: Data Issues, and Lessons Learned

Controls: Customer, LR Plan, and LR Procedures

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A5.3 Identify Payment Issues

Payment issues are identified by comparing the Financial Data collected during the execution phase to the Financial Documentation, and Refined Cost Estimate. Some Payment Issues that could arise include deviations from the Refined Cost Estimate or funding not received by any Logical Range Resource provider.

Inputs: Financial Data

Outputs: Payment Issues, and Lessons Learned

Controls: Customer, LR Plan, and LR Procedures

Mechanisms: Subject Matter Experts, Support Staff, and Tools

A5.4 Resolve/Close Payment/Data Issues

During this activity any payment or data issues are reconciled to the satisfaction of the Customer, Logical Range Manager, and any facility or range which participated during the Logical Range instance.

Inputs: Data Issues, and Payment Issues

Outputs: Lessons Learned, Customer Data Package, and LR Lessons Learned

Controls: Customer, LR Plan, LR Procedures, Refined Cost Estimate, and Financial Documentation

Mechanisms: Subject Matter Experts, Support Staff, and Tools

As distributed exercises or tests are integrated with traditional autonomous range tests there are a variety of business process related issues that need to be addressed. These include:

1. Resolution of scheduling, and planning conflicts at all levels (customer, range, Fleet, joint).

1. Integration of logical range scheduling process with current scheduling

process. Parallel operation of traditional range with logical range.

1. Contingency planning with respect to live participants (changes in weather, security, safety, schedule, priority, etc.), what feedback loops accommodate this?

1. Test/Training community objective misalignment, and conflicts (acquisition test, operational test, small team training, theater level training, etc.).

1. Selection of assets to be made interoperable (and funding to do it).

1. Execution of simultaneous overlapping logical ranges.

1. Assignment (and execution) of responsibilities (security, safety, test director, asset controller etc.) for logical range operation.

1. Merging of multiple cultures, and communities (terminology, process order, chain of command, Service perspective, warfare specialty, etc.).

1. Exercise VV&A. Are multiple objectives being accomplished, and how well?

1. Recognition that perfecting the "logical range" process is an iterative learning process.

1. Utilizing foreign assets and servicing foreign customers.

1. Situational awareness of all exercise participants and assets.

The Logical Range crosses physical and Service boundaries to achieve seamless interoperability, sharing and reuse of resources. To achieve the goal of enabling the multi-site, and multi-Service Logical Range environment, management and cultural changes will be needed. The LRBPM offers common procedures and processes to enable a cost and time efficient capability to meet warfighter test and training needs.

The LRBPM provides ranges and facilities with a defined process to conduct a test or training exercise in a distributed, multi-site, multi-Service environment. The following recommendations will help further develop and refine the LRBPM as it transitions to the test and training community.

- Promulgate the Logical Range Business Process Model for community review and discussion,

- Validate the LRBPM by following the process in a real environment,

    - Compare to current facilities/ranges business processes, and determine levels of compliance to legacy systems,

- Conduct paper walk -through, and
- Define and document specific support tool requirements for the Logical Range. This should be coordinated with other related programs.

- Determine if lower level of detail is needed for process viability, and
- Create a Logical Range Business Process user guide.

BoOD	Board of Operating Directors
CTEIP	Central Test and Evaluation Investment Program
DoD	Department of Defense
IDEF0	Integrated Computer Automated Manufacturing Definition
JPO	Joint Project Office
LR	Logical Range
LRBPM	Logical Range Business Process Model
NUWC	Naval Undersea Warfare Center
TENA	Test and Training ENabling Architecture
TERC	Test and Evaluation Resource Council
TERIB	Evaluation Reliance and Investment Board
TRA	Technical Reference Architecture

[AFWTF 1992] Manual for the Utilization of Atlantic Facility Weapons Test Facility, December 1992.

[AUTEC, 1994] Atlantic Undersea Test and Evaluation Center, Range Manual, December, 1994.

[Eglin, 1996] Program Engineer's Guide, 46th Test Wing Pamphlet 99-102, 103, Eglin AFB, April 1996.

[JPO, 1995] TE Enterprise Model, Joint Program Office, June, 1995

[PMRF, 1991] Range User's Handbook, Pacific Missile Range Facility, Hawaiian Area, Barking Sands, Kekaha, HI, September, 1991

[WSMR 1994] Test Officer Handbook, White Sands Missile Range, Electronic Proving Grounds, Ft. Huachuca, 1994.

Ranges and Facilities Visited

Aberdeen Proving Grounds

Atlantic Facility Weapons Test Facility

Atlantic Undersea Test and Evaluation Center

Eglin Air Force Base

Naval Undersea Warfare Center, Northwest Ranges

Pacific Missile Range Facility

United States Marine Corps Amphibious Vehicle Test Branch, Camp Pendleton, CA

White Sands Missile Range, Electronic Proving Grounds, Ft. Huachuca

The Following Section contains an alphabetized list of definitions for the LRBPM arrows and activities.

Closeout - During this activity all performance and data/cost issues are resolved, the customer data package is delivered and financial matters are closed.

Collect Customer Feedback - During this activity the LR manager in conjunction with the facilities involved in the execution of the plan will query the customer for comments regarding the quality, accuracy, and overall management of the test/training exercise.

Compile LR Plan - Organization, and assembly of all required information for the test/training exercise execution plan.

Conduct a Logical Range Test/Training Exercise - This activity describes process to conduct a test/training exercise in the Logical Range environment. It illustrates the major inputs, outputs, controls, and mechanisms required for the process.

Coordinate Secondary & Support Requirements - The planning, organization of facility or range specific support resources, and services required by the LR test/training exercise for execution.

Cost Estimate - Initial cost based on preliminary review of the scenarios, and cost information provided by the supporting facilities, and ranges.

Customer - Person, command, or organization that has a need to sponsor an exercise. The customer controls the phases of the test or training exercise , and also collaborates with ranges/facilities management in the planning, scheduling, executing, and reviewing

activities.

Customer Data Package - The final product of a test or training exercise. The format of the data package is outlined in the test/exercise plan providing step-by-step instructions for acquiring, reducing, and analyzing data.

Customer Feedback - Customer's opinion regarding the test/training exercise from first contact with the LR Manager to Closeout.

Customer Requirements - The purpose, objective, events, conditions, or qualifying factors or desired resources of a test or training exercise. One example of customer requirements could be: Determine if the M1A1 Battle Tank can come to a full stop on a 60 degree incline, restart, and climb to the top of the grade without exceeding 4500 ft. lbs. of torque at a predetermined test point in the suspension system. The length of the of the incline, coefficient of friction, specific location of test point, weather conditions, budget, and timeline would also be specified.

Data Issues - Issues that developed regarding the Customer Data package. These could be related to data processing, data display, or data collection.

Data Products - All products produced during the test/training exercise as per the detailed LR Plan.

Debrief - Post execution assessment of the LR test/training exercise.

Debrief Report - Issues that arise during the test/training exercise. These can be attributed, but not limited to: engineering, technology, weather or management performance.

Define a Logical Range Scenario - During this activity the LR Scenario that best meets customer requirements is determined. There may be several valid scenarios which can be used to achieve the same test/exercise objectives. The customer, and the LR Manager determine the best candidate to achieve Customer Requirements satisfaction based on resource/technology/capability availability, time or budget constraints, and other factors.

Define Scenario Characteristics - During this activity the attributes of a LR Scenario that will meet customer requirements are delimited. They will be used to define candidate scenarios. Characteristics include: type of test/training exercise, environment, events, participants, or the need for particular LR Resources.

Define Scenarios - During this activity the customer, and the LR Manager will define scenarios based on the Scenario Characteristics previously defined. The Customer, and the LR Manager will utilize the LR Support Tool to generate scenarios that meet Customer Requirements, and Scenario Characteristics.

Define Secondary & Support Requirements - Identification of test/training exercise facility/range specific requirements as well as logistics support requirements. Logistics support could include financial, communications, computation, personnel, security,

safety, and environmental resources.

Determine Primary Resources Availability - During this activity the accessibility of high-level or essential resources is determined utilizing the Primary Schedule Requirements, the Joint, Facilities/Ranges Schedules, and the LR scheduling tools, and procedures.

Develop Cost Estimate - This activity develops the test/training exercise estimated costs based on the Scenario Requirements, and cost information provided by the supporting facilities/ranges.

Establish LR Operating Financial Environment - During this activity the LR Manager generates the required financial documentation for each organization involved in the Logical Range.

Execute - During this activity the operational steps outlined in the LR Plan will be followed in order to conduct the LR test/training exercise.

Execute Plan - During this activity the execution of the LR Plan is followed beginning with the setup for the exercise, execution, preparation of the Preliminary Data Package, and final debrief of the exercise.

Facilities/Ranges Capability Description - Functional, managerial, operational, and performance specifications as well as costing information of facility/range resources.

Financial Data - Cost-related information derived, and collected during the plan execution activity.

Financial Documentation - The set of formal financial records required for the conduct of a LR test/training exercise.

Identify Payment Issues - Payment issues are identified by comparing the Financial Data collected during the execution phase to the Financial Documentation, and Refined Cost Estimate. Some Payment Issues that could arise include deviations from the Refined Cost Estimate or funding not received by any Logical Range Resource provider.

Joint, Service Ranges/Facilities Schedules - All official records of the utilization timeline for LR assets. These are compiled from facilities such as hardware in the loop, installed test facilities, T&E, and training ranges, as well as Joint and Commanders in Chief schedules.

Lessons Learned - Managerial or operational understanding derived from the execution of this particular process or activity. This information is collected and analyzed for process improvement purposes.

Logistics Annex - Document that outlines Safety, Environmental, Air/Water Space plans and other logistics issues. This document is developed should include particular chapters dedicated to the documentation of particular facility/range resource/services provider information.

Logs - A chronological documentation of the test/training exercise events.

LR Lessons Learned - A compilation of specific managerial, operational, performance or financial information that pertains to the Logical Range instantiation. These will be kept on a Logical Range repository for analysis, and future review of Logical Range users.

LR Plan - Detailed account of all critical operational test/training exercise information to include: exercise events, objectives, resources requirements, and allocation (divided by provider), execution planning, cost estimate, and timelines.

LR Procedures - The managerial and operational doctrine, and processes that govern, and provide guidance for all phases of the execution of a LR test/training exercise. These may include safety, security, environmental, communications, financial, and computational procedures.

LR Scenario - The particular scenario selected to be utilized for planning of the Logical Range.

LR Working Schedule - The timeline assigned to the LR for the utilization of high-level or essential assets, and resources required to execute a Logical Range test/training exercise.

Match Capabilities to Scenario Requirements - This process will utilize existing facilities/ranges capabilities, and defined scenarios to determine if customer requirements can be met.

Matched Requirements - The specific facilities/ranges resources required to execute the test/training exercise.

Optimize Schedule - During this activity the facilities/ranges schedules, and the LR Primary Resources Availability Report are utilized in conjunction with the schedule optimization tool to generate Optimized LR Resources.

Payment Issues - The result of any deviations from the Refined Cost Estimate or financial consequences that arise during the test or training exercise. Examples of Payment Issues include deviations from the Refined Cost Estimate or funding not received by any Logical Range Resource provider.

Plan - Preparation, coordination, and production of the detailed LR Plan. During this activity there are four efforts - establishing LR operating financial environment, define, and coordinate secondary, and support requirements (included in the Logistics Annex), and compilation of the LR Plan.

Preliminary Data Package - Post-test/training exercise results formatted and processed as per LR Plan. This package will be presented to the customer for review and approval for delivery.

Prepare Preliminary Data Package - Compilation of the test/training exercise data before it has been reviewed by the Customer to determine accuracy and completeness.

The format, presentation, and delivery of the Preliminary Customer Data Package will be specified in the LR Plan.

Pre-Test/Training Exercise Brief - A summary of all the events, and coordination related with the test/training exercise. All parties involved from safety, environmental, engineering, and management will be involved at levels of correspondence. At this point the plan and schedules should be cleared and understood by all parties involved.

Primary Resources Assignments - The specific combination of high-level or essential LR resources to be utilized during the execution of the LR test/training exercise.

Primary Resources Availability Report - Report containing the corresponding timeframe of primary (high-level or essential) resources availability.

Primary Schedule Requirements - Logical range high-level or essential resources' time assignment.

Questionnaires - Tools utilized to measure success for technical, operational, planning, and funding issues.

Ranges/ Facilities Procedures - The official managerial and operational doctrine, and processes that control and provide guidance for the execution of a test/training exercise at a specific facility or range.

Refined Cost Estimate - A detailed cost estimate that takes into consideration all support required to conduct the test/training exercise.

Resolve/Close Payment/Data Issues - During this activity any payment or data issues are reconciled to the satisfaction of the Customer, Logical Range Manager, and any facility or range which participated during the Logical Range instance.

Scenario Characteristics - The set of acceptable boundaries or specifics for a particular scenario. These boundaries are selected as inputs, ranges or limits for the construction of the scenarios. Scenario characteristics include: type of test/training exercise, environment, events, participants, or particular LR Resources.

Scenario Requirements - A set of high-level or essential resources, services or operations necessary for the scenario execution.

Scenarios - The combination of environment, participants, LR Resources, and events which can be used to meet the test/training exercise customer requirements.

Schedule Logical Range - During this activity the LR primary resources will be scheduled following established LR scheduling procedures and utilizing the LR scheduling tools.

Secondary & Support Requirements Definition - A list of facility/range specific support services, and assets definition accompanied by proposed provider(s).

Select Implementation Scenario - During this activity the LR Manager in conjunction

with the Customer decide the LR Scenario to be used to conduct the test/training exercise.

Setup - The steps followed to prepare for plan execution. These are LR specific and will follow LR Procedures as well as Ranges/Facilities Procedures.

Subject Matter Experts - Test/Training exercise personnel who are called upon to perform the tasks required to conduct the Logical Range.

Support Staff - The required test/training exercise personnel. These include, but are not limited to: test engineers, program/test managers, data analysts, range safety officers, and programmers.

Tools - The required manual or automated systems to support the Logical Range. Tools could support scheduling, financial planning, test/training exercise conduct, or data analysis.

Unmatched Requirements - A report that identifies what requirements could not be matched and explains the reasons why.

Verify Preliminary Data Package - During this activity the preliminary data package is validated against the specifications outlined in the plan. The customer may be part of this activity and may accept or reject the data package.

The following sections contain the business processes provided to the TENA project by test and training ranges, and other related programs. These together with information gathered through interviews with subject matter experts, were used to develop the current or "as-is" model contained in Appendix D.

ATLANTIC FLEET WEAPONS TEST FACILITY

The following figure depicts a high-level process for the Atlantic Fleet Weapons Training Facility:

ATLANTIC UNDERSEA TEST AND EVALUATION CENTER

Eglin AIR FORCE BASE

The following figures depicts a high-level process for Eglin AFB Facility:

PACIFIC MISSILE RANGE FACILITY

1. IDEF0 IS FOR UNDERSTANDING SYSTEMS VIA MODELING

IDEF0 is a technique that enables people to understand complex systems, and enables

them to communicate their understanding to others.

As used here, a "system" may be defined as any combination of machinery (hardware), data and people, working together to perform a useful function. IDEF0 may be applied in planning, analysis, design, project management, or whenever documented understanding of a complex subject is useful. The result of applying IDEF0 is a "model" that shows, in a series of diagrams, the understanding gained.

2. "TOP-DOWN" ORGANIZATION OF THE MODEL

The diagrams in a model are organized in a hierarchic and modular "top-down" fashion, showing the breakdown of the system into its component parts. Application of IDEF0 starts with the most general or abstract description of the system to be produced. If this description is contained in a single "module", represented by a box, that box is broken down into a number of more detailed boxes, each of which represents a component part. The component parts are then detailed, each on another diagram. Each part shown on a detail diagram is again broken down, and so forth, until the system is described to any desired level of detail. Lower level diagrams, then, are detailed breakdowns of higher level diagrams. At each stage of breaking down the system, the higher level diagram is said to be the "parent" or overview of the lower-level "detail" diagrams.

3. DIAGRAMS ARE INDEXED BY NODE NUMBERS

In an IDEF0 diagram, the component parts are shown as numbered boxes. A diagram should have no more than six boxes. Each box is detailed in one diagram at the next lower level until a sufficient level of detail is reached.

The place of each diagram in a model is indicated by a "node number", derived from the

numbering of boxes. For example, A21 is the diagram which details box 1 on the A2 diagram. Similarly, A2 details box 2 on the A0 diagram, which is the top diagram of the model. This hierarchy may be shown in an index of diagram names and their node numbers called "node index". The node index serves as a table of contents for a model.

The example shown below says that providing develop system (A0) is broken down into three sub-functions, A1 through A3. Design system (A2) is further broken down into three, more detailed sub-functions, (A21 through A23).

Figure

4. DIAGRAMS CONSIST OF LABELED BOXES AND ARROWS

In IDEF0, boxes represent components in the breakdown, and arrows represent relationships between these components. Descriptive labels are written inside each box and along each arrow to describe their meaning. The notation is kept simple to permit easy reading with little special training.

The following is a sample IDEF0 diagram. Notice that the boxes represent the breakdown of activities or functions performed by the system and are named by verbs. Arrows, which represent objects or information are labeled with nouns. This emphasizes system functions and is called actigram. It is the usual kind. When data or objects are emphasized the boxes are labeled with nouns and the arrows are verbs. This type of diagram is called a datagram.

5. BOX AND ARROW SYNTAX

The sample IDEF0 diagram shows that the descriptive names and labels convey the box and arrow contents to the reader.

In addition to its label, the side at which an arrow enters or leaves a box shows its role as an input, control, output, or mechanism for the box.

Arrows may branch or be joined. The branches may each represent the same thing, or different things of the same general type.

6. ARROWS SHOW THE CONNECTION BETWEEN PARENT AND DETAIL DIAGRAM

Some arrows show both their source and destination boxes on the same diagram, while other arrows have one end unconnected. The unconnected arrows represent inputs, controls, or outputs of the parent box. To find the source or destination of these unconnected arrows, the reader must locate the matching arrows on the parent diagram. All such unconnected arrows must continue on the parent for the diagrams to be complete.

Although arrow connections from parent boxes to detail diagrams may be obvious from the labels, a special notation allows readers to do the match quickly. The letter I, C, O, or M is written near the unconnected end of the arrow on the detail diagram, to identify that the arrow is shown as an Input, Control, Output, or Mechanism on the parent box. To pinpoint the arrow more precisely, this letter is followed by a number giving the relative position at which the arrow is shown entering or leaving the parent box, numbering left to right and top to bottom. For example, "C3" written on an arrow in the detail diagram indicates that this arrow is shown as the third control arrow entering the parent box. These identifications are written on the matching arrows of the detail diagram.

Using this letter/number matching scheme, an arrow may have a different (but compatible) descriptive arrow label on the parent diagram and the detail diagram, if appropriate.

Also, an arrow shown as control or as input on a parent diagram is not limited to the same role on a detail diagram (i.e., C2 on the parent box appears as an input to box 1 on its detail diagram in the example below).

In very special cases, an unconnected arrow on a detail diagram has no matching arrow on its parent, or vice versa. In this case, the arrow head or tail is shown enclosed in parentheses.

Inputs (on the left) are transformed into outputs (on the right). Controls (on the top) govern the way the transformation is done. Mechanisms (on the bottom) indicate the means by which the function is performed. A "mechanism" (or support) might be a person or a committee or a machine or a process.

Arrows represent single things or general classes of objects or information. The arrow label describes what the arrow represents. The arrow structure of an IDEF0 diagram represents a constraint relationship among the boxes. It does not represent flow of control or sequence. The arrows entering a box show all that is needed by the box to perform its function. Therefore, the box is constrained by its input and control arrows. An output of one box may satisfy some or all of the input or control conditions required by one or more other boxes. It is not necessary that each and every box have input and control and output. Also, several boxes can be performing their functions simultaneously.